Original Research Article

PrimaryChecklistofPhytoplanktonGenerain SunyeLake, Mandalay Region,Myanmar

ABSTRACT

Phytoplankton are the foundation of food webs and the most important producer inaquatic ecosystems. They can photosynthesize and convert light energy into organic energy.They are a secrete ingredients used as a bioindicator of water quality and pollution. Thisstudy investigated composition of phytoplankton in freshwater body of Sunye lake, Mandalayregion. The study was conducted one year from January 2020 to December 2020. Accordingto the study, out of 47 total algal genera; Chlorophyceae (14 genera), Baciliophyceae (11genera); Cyonophyceae (nine genera); Zygnematophyceae (two genera), Euglenophyceae(one genera) and Conjugatophyceae (one genera) were recorded. In this study, among totalgeneraof37,theclassofChlorophyceae(45%)isthelargestgroupfollowedbyBaciliophyceae(28%), Cyanophyceae(19%), Zygnematophyceae(4%), Euglenophyceae(2%)and Conjugatophyceae (2%). This present check list study will be useful base line data forfurtherstudyofphytoplankton in the lake.

Aims: The aim of study is to record and give the information's of phytoplankton existenceanduseful data forfurtherstudyand lake ecosystem.
Study design: Thewatersamplewascollectedmonthlyearlymorningonceaweekthroughoutthe studyperiod.
Place and Duration of Study: This sample were collected from natural freshwater Sunyelakeduring January2020 toDecember2020foroneyearperiod.
Methodology: Phytoplankton samples were taken by filtering through 25 µm mesh planktonnet and preserved with a Lugol's solution and kept in refrigerator for further study. Thesamplewasidentifiedandtookphotographbyusingthemicroscope(OPTIKA).Theresultsof phytoplankton were checked with phytoplankton identification key, taxonomic databasesite.
Results: Inthepresentstudy,47generabelongtothesixdifferentclassesofphytoplanktonswererec ordedchlorophyceae,baciliophyceae,Cyonophyceae,Zygnenophyceae,Euglenophyceae,Conj ugatophyceae.
Conclusion: The current study is first time to study the checklist of phytoplankton in SunyeLake and should be continuously study to update the checklist data of phytoplankton generaandseasonallyabundancewhich isimportantindicatorsoflakeecosystem.

Keywords:Algae, Chlorophyte,Freshwater, Ecosystem

1.INTRODUCTION

Atinysmallmicroscopicplant,phytoplanktonisanimportantbasicspeciesoffoodwebandasasourceof nutrientinaquaculture.Theseorganismshaveanextremeecologicalimportanceinthedifferentwaterb odiesworldwide,astheyfixedcarbondioxide,produceoxygenandareimportantkeyelementinthebasis ofvariousfoodchains[3].Phytoplanktonarementionedaspollutionindicatorspecies[6]andpresenceof phytoplanktonreflectedthestatusofwaterquality[2].Phytoplanktonarerenewable,sustainableandec onomicalsourcesofbiofuels,bioactivemedicinalproductsandfoodingredients[15].Speciescompositi onofalgaeformedundertheinfluenceofnutrientsource,morphometrythechemistryandhistoryoftheus eofeachofthelakes[16].Manyfeaturedsuchaswidth,discharge,substratum size, light,temperature and depth also affect the species compositionsand

productivity ofloticenvironments[6].

Checklistisimportantforecologicalstudy,monitoringandconservationecosystemandneedtobeupdated,withoutbaselineinformationitisdifficulttostudyanychanges.A regularchecklistspeciesoccurstoquicklydeterminethepresenceofnewandpossibly, invasivespeciesinthefreshwatersystem[20]. Regularchecklistspeciesisvitalinmonitoringexistenceofnativespecies.Studyphytoplanktonhelpunderstandsuchaschanges infishstocks,pollutionandclimate.

SunyeLake,MandalayRegion,ithas beenformedasanaturalfreshwaterlakeincentraldryzone(typically500-1000mmofrainperyear)[21][8]since11centauryAD.Thisareacoveredhas537hawith150mabovesea level.Themaximumdepthofthelakeis3.1mandtheaveragedepthis1.5m.Manyhillsandhillockssurroundedtothelakewhichformsthenaturalreservoirs.Mainly water sources are come from Zawgyiriver that flows into the Thin Dwe canal and directly to the lake.Itisprovidingimportantwaterresourcesforhouseholdusageandirrigation.Thepresentstudyisfirsttimeinvestigationandchecklistofbasicaquaticphytoplanktongenera.Theaimofstudyistorecordandgivetheinformation'sofphytoplanktonexistenceandusefuldataforfurther study andlakeecosystem.

2.MATERIALANDMETHODS

2.1StudyAreaandProcedure

ThissamplewerecollectedduringJanuary2020toDecember2020forone-yearperiod.Geographically,thislakeliesbetweenN 21° 40 ′ 40.84″ longitude and E 96° 13′ 45.96 ″ latitude, location figure is generated with QGIS 3.28.13 version (figure1).Thewatersamplewascollectedonceaweekmonthlyandearlymorningat8;00Amto9;00Amthroughoutthestudyperiod.Phytoplanktonsampleswereapproximately 16 inches to 18 inches from the surface water of three different sampling areas. 20litersofwatersamplewasfilteredandpassedthroughin100mLpolythenebottleswhichtightlytiedwith 25µmmesh

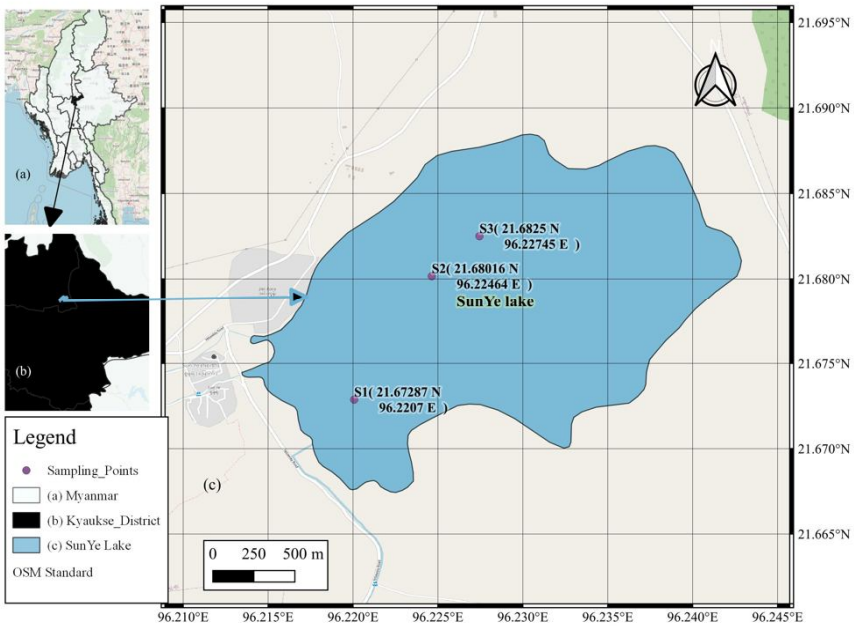


Fig.1.LocationmapoftheSunyeLake

theplanktonnet.Collected100mL phytoplanktonsampletobeanalyzedanditwaspreservedinaLugol'ssolutionimmediatelypackingwith blackplasticbag.ThePreservedsamplewaskeptinrefrigeratedcondition about48hours forfurtherstudy.

2.2PhytoplanktonIdentification

Thesamplewasidentifiedandtookphotographbyusingthelight microscope(OPTIKA) andimages were taken photographs with an 60X objective.The resultsofphytoplanktonwerecheckedwithphytoplanktonidentificationkey,taxonomic databasesitealgaebase.comandmonograph.Easyidentificationofthemostcommon freshwater algaeby[30]was usedasmainreferencebook.

3. RESULTS ANDDISCUSSION

Inthepresentstudy,47generabelongtothesixdifferentclassesofphytoplanktonswererecordedintable 1andspeciescompositionsisshowninfigure2.Microscopicimageofphytoplanktonsareshowninfigure 3,4and5.Thirteendifferentgeneraofchlorophyceaeclasswerefound,theyare*Colostrum*sp,*Quadrigul a*sp,eightdifferent*Scendesmus*sp.,threedifferent *Pedistrum*sp.,*Selenastrum*sp.,*Chlorella*sp.,*Monoriphidium*sp.,*Chlorogoniumsp*sp.,*Chlorococcum* sp.,*Golenkinia*sp.,*Dictyosphaeria*sp.,*Oocystis*sp.,*Westella*sp.

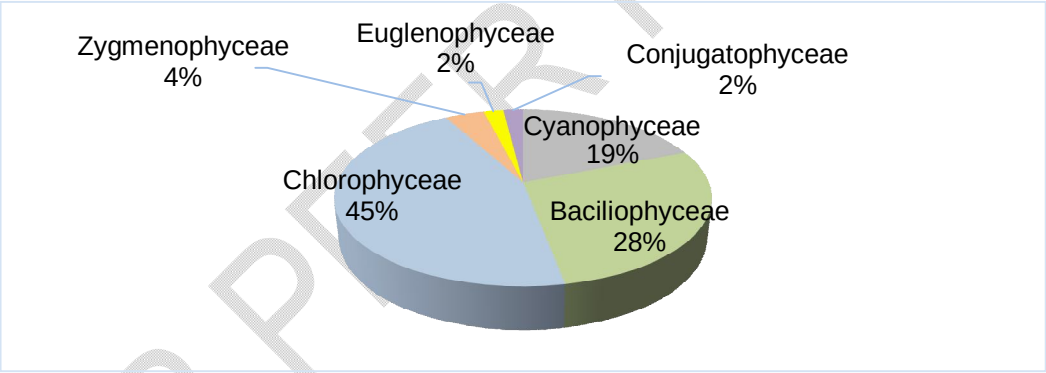


Fig. 2. Percentageofphytoplanktoncompositionbyclassin SunyeLake.

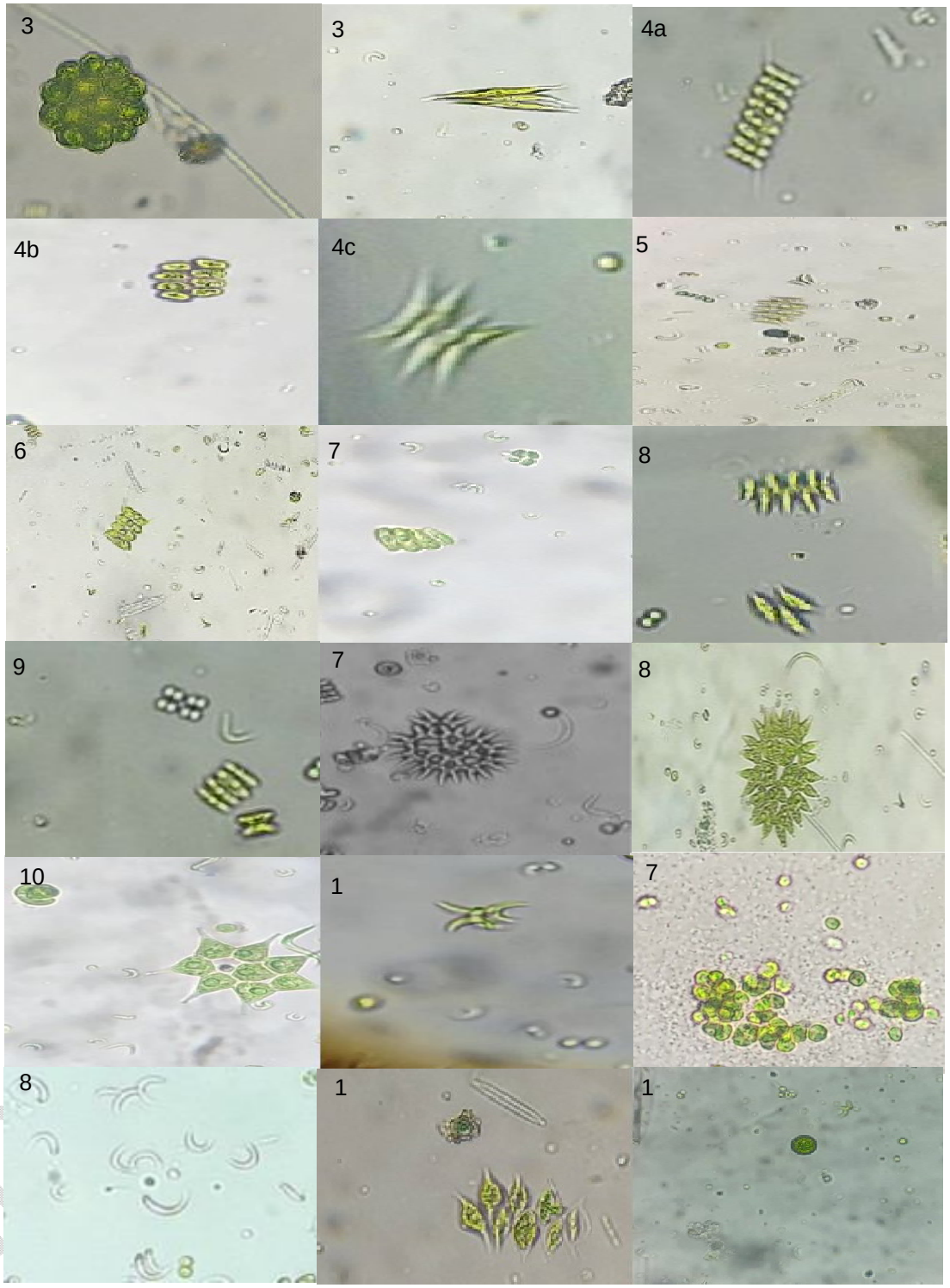
Chlorophyceaewerethehighestspeciescompositionwith45%.TheChlorophyceae,freshwater greenalgaearealargeandimportantgroup,they includesomecommonspeciesandmany membersareimportant bothecologicallyandscientifically.TheChlorophyceaeencompassthewidestrangeofmorphologiesin thegreenalgaeandincludednearlyallgreenalgae[29][17].Atotalof99phytoplanktontaxabelongingto5 0generawererecordedfromYezinDam,12belongedtoChlorophyceae[27].Fourtypesofphyla,37alga lspecieswererecordedinMyaKanTharLake,LoilemTownship,Chlorophyta,Chlorophyceaegroupsw asalsohighest[24].Total18Chlorophytaalgalspecies wererecordedinNaung-yar LakeLoikawcity[23].

Baciliophyceaewerethesecondhighestnumberofspecieswith28%inpresentstudy.Thesegroupisals ocalleddiatom.ElevenBaciliophyceaeclassrecordaretwo*Fragilaria*sp.,two*Synedra*sp.,two*Pinnulari a*sp.,*Cyclotella*sp.,*Craticula*sp.,*Naviculas*p.,*Aulacoserioa*sp.,*Merismopedia*sp.,*Phormidium*sp.,*C ymbella*sp.*andNitzchia*sp.Currentresearchfindingwassimilarwithreportfrom IndawgyiLakeinwhicht heChlorophyceae

showedthehighestnumber ofspecies,diatom is thesecondhighest[10].Diatoms arefoundbothinthemarineandfreshwatercolumnasphytoplanktonaswellas onthebedasbenthicmicroalgaeormicrophytobenthos[31].Diatomarereportedaspollutionindicatorof wetlandandreservoir [11].Applications of diatomanalysisis nowcommonly usedinarchaeology[7]. In thisstudy,nineCyanophyceae,*Oscillatoria*sp.,*Anabaena*sp.,*Spirulina*sp.,*Mycrocystissp.*,twodifferent*Tetraedron*sp.,*Gloeocapsa*sp.,*Nostoc*sp.,*Arthrospira*sp.,and*Chrococcus*sp.wererecordedwith19%.Someother freshwater phytoplanktonstudiedhavebeenreportedinMyanmar.Atotalof70algalspecieswererecordedfrom

Table1.ListofPhytoplanktoninSunye Lake.

No	Genus	Family	Order	Class
1	*Coelastrum*	Scendesmaceae	Sphaeropleales	Chlorophyceae
2	*Quadrigula*	Oocystaceae	Trebouxiophyceae	Chlorophyceae
3	*Scendesmus*	Scendesmaceae	Sphaeropleales	Chlorophyceae
4	*Pedistrum*	Hydrodictyaceae	Sphaeropleales	Chlorophyceae
5	*Selenastrum*	Selenastraceae	Sphaeropleales	Chlorophyceae
6	*Chlorella*	Chlorellaceae	Chlorellales	Chlorophyceae
7	*Monoriphidium*	Selenastraceae	Sphaeropleales	Chlorophyceae
8	*Chlorogonium*	Haematococcaceae	Chlamydomonadales	Chlorophyceae
9	*Chlorococcum*	Chlorococceae	Chlamydomonadales	Chlorophyceae
10	*Golenkinia*	Neochloridaceae	Sphaerophyceae	Chlorophyceae
11	*Dictyosphaerium*	Chlorellaceae	Chlorellales	Chlorophyceae
12	*Oocystis*	Oocystaceae	Chlorellales	Chlorophyceae
13	*Westella*	Scendesmaceae	Sphaeropleales	Chlorophyceae
14	*Fragilaria*	Fragilariaceae	Fragilariales	Baciliophyceae
15	*Synedra*	Fragilariaceae	Fragilariales	Baciliophyceae
16	*Pinnularia*	Pinnulariaceae	Naviculales	Baciliophyceae
17	*Cyclotella*	Stephanodiscaceae	Thalassiosirales	Baciliophyceae
18	*Craticula*	Stauroneidaceae	Naviculales	Baciliophyceae
19	*Navicula*	Naviculaceae	Naviculales	Baciliophyceae
20	*Aulacoseria*	Aulacoseria	Centrales	Baciliophyceae
21	*Merismopedia*	Chrococcaceae	Centrales	Baciliophyceae
22	*Phormidium*	Ocillatoriaceae	Centrales	Baciliophyceae
23	*Cymbella*	Cymbellaceae	Cymbellales	Baciliophyceae
24	*Nitzschia*	Bacillariaceae	Bacillariales	Baciliophyceae
25	*Oscillatoria*	Oscillatoriaceae	Oscillatoriales	Cyanophyceae
26	*Anabaena*	Nostoceae	Nostocales	Cyanophyceae
27	*Spirulina*	Spirulinaceae	Spirulinales	Cyanophyceae
28	*Microcystis*	Microcystaceae	Chroococcales	Cyanophyceae
29	*Tetraedron*	hydrodictyaceae	Shaeropleales	Cyanophyceae
30	*Gloeocapsa*	Chrococcaceae	Chrococcales	Cyanophyceae
31	*Nostoc*	Nostocaceae	Nostocales	Cyanophyceae
32	*Arthrospira*	Microcoleaceae	Oscillatoriales	Cyanophyceae
33	*Chrococcus*	Chroococcaceae	Chroococcales	Cyanophyceae
34	*Staurastrum*	Desmidiaceae	Desmidiales	Zygmenophyceae
35	*Zygnema*	Zygnemataeae	Zygnematales	Zygmenophyceae
36	*Euglena*	Euglenaeae	Euglenida	Euglenophyceae
37	*Closterium*	Closteriaceae	Desmidiales	Conjugatophycea



100
101 **Fig. 3.Thelistofrecordedphytoplanktonspeciesin SunyeLake(60X-magnification),1.*Coelastrum*sp.,2.*Quadrigula*sp.,3a.3b.3c.3d.3e.3f.3g,3h.*Scendesmus*sp., 4a.4b.4c.*Pedistrum*sp.,5.*Selenastrum*sp., 6.*Chlorella*sp., 7.*Monoriphidium*sp., 8.*Chlorogonium*sp.,9.*Chlorococcum*sp.**

IndawgyiLake in 2020,speciesofcyanobacteriawerethemostabundantlyoccurred,themostpresentcyanobacterialspecieswere*Microcystis*[10][4].13familyofalgaewerereportedandcyanobacteriawerethedominantgroupinMeiktilalakein2017[5].Cyanobacteriaisgreatnitrogenfixerwithphotosyntheticcapabilitiesusefulby-productsandbio-fuels,enhancingthesoilfertilityandreducinggreenhousegasemissions.Theseareofferedbio-agentsasthepreciousbio-resourceforsustainabledevelopment [26]. Cyanophyceaecan

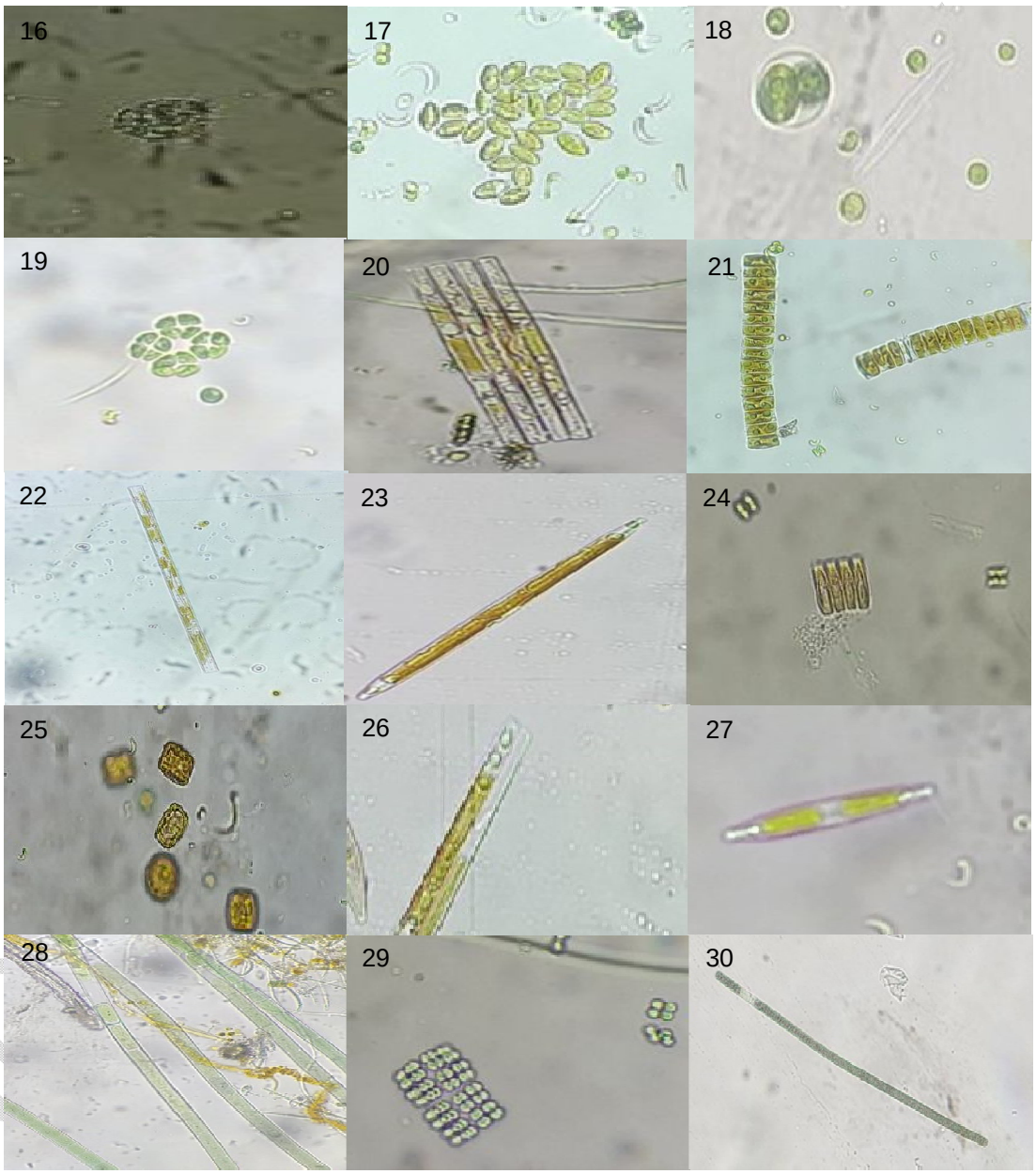
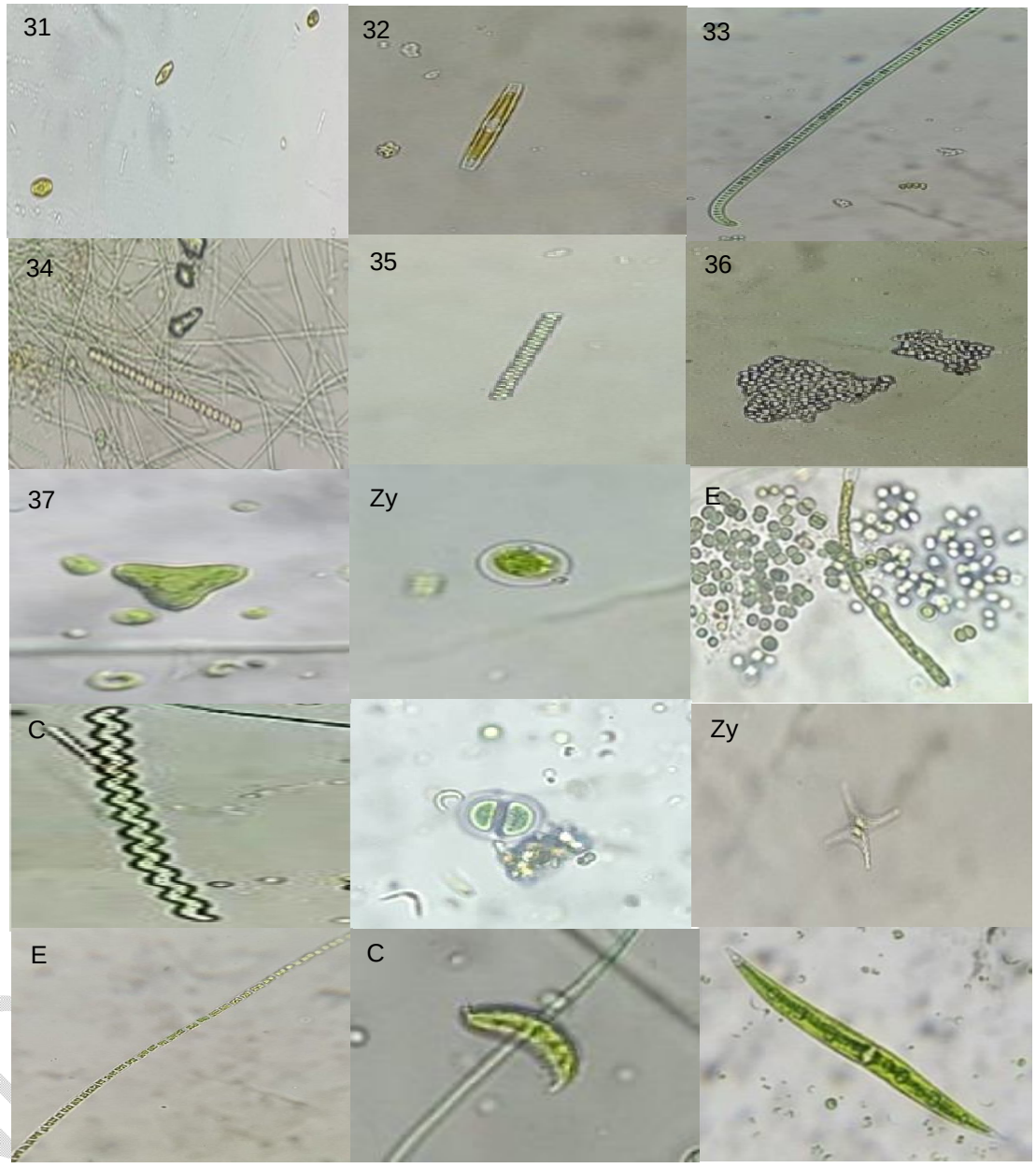


Fig.4.Thelistof recordedphytoplanktonspeciesinSunyeLake(60X-magnification),10.*Golenkina*sp.,11.*Dictyosphaerium*sp.,12.*Oocystis*sp.,13.*Westella*sp.,14 a.14b.*Fragilaria*sp.,15a.15b.*Synedra*sp.,*16.Pinnularia*sp.,*17.Cyclotella*sp.,*18.Navicula*sp.,*19.Craticula*sp.,*20.Aulacoseria*sp.,21.*Merismopedia*sp.,*18.Navicula*sp.,*19.Craticula*sp.,*20.Aulacoseria*sp.,21. *Merismopedia*sp., 22.*Phormidium*sp.

104contaminate surfacewatersuppliesmostlyduringwarmsummermonths.Thetoxiccomponentismicrocystin.Bloomsofsomespeciesreleasetoxinsandleadtoanoxiainthehabitatofbiota.Cyanobacteriathatinhabitawidevarietyofhabitatsas freeliving,epiphytic,symbiotic orparasitic plants [19].Species compositionis highlysensitivetowater

105

106



107

108 Fig.5.Thelistofrecordedphytoplanktonspeciesin Sunye Lake(60X-magnification),23.*Cymbellasp.*,24.*Nitzchia*sp.,*25.Oscillatoria*sp.,26.*Anabaena*sp.,27.*Spirulina*sp.,28.*Microcystis*sp.,29.*Teradon*sp.,30.*Gloeocapsa*sp.,31.*Nostoc*sp.,32.*Arthrospir*sp., 33.*Chroococcus*sp.,*34.Starastrum*sp.,*35.Zygnema*sp.,36.*Euglena*sp.,37.*Closterium*sp.

quality and many species are habitat specific [14] and they may be reliable indicator organisms [22]. Current study finds the pollution indicator species like *Microcystic* species but no pollution was occurred due to macrophyte.

Zygnenophyceae, *Staurastrum* sp. and *Zygnema* sp. were found in this study with 4% in species composition. Zygnematophyceae, are the most diverse green algae, the closest lineage to land plants and are useful model organisms for plant evolution study due to their morphology, cell wall and sexual reproduction [13][12][28]. They consist of unicellular and filamentous algae, occupying freshwater and terrestrial habitats, whose developmental features are very difficult to compare with the complexity of land plant [9].

Euglenophyceae can be considered as useful bio-indicators in assessing the health and extent of deterioration of a lake ecosystem [1], *Euglena* genera was recorded in the month of January and July in 2020, composition was 2% during this study.

In this study, species composition of Conjugatophyceae, *Closterium* sp. was 2%. The genus *Closterium*, which is the closest unicellular relative to land plants, is the best characterized charophyceangreen algae with respect to the process of sexual reproduction [25] and reported as bio-catalyst used for fuel and chemical production [18].

4.CONCLUSION

Checklist of phytoplankton is important for ecology study and conservation of the Lake. The current study is first time to study the checklist of phytoplankton in Sunye Lake and help to provide checklist data of phytoplankton genera and their compositions for further study and lake ecosystem management.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.
2.
3.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge Department of Biotechnology Research (DBR), Ministry of Science and Technology, Kyaukse for providing financial and laboratory facilities. The authors would like to thank Dr. Aung KhaingPhyo, researcher, DBR who have helped the manuscript preparation.

REFERENCES

1. Ajayan AP, Rijstenbil JW, Kumar KGA 2. Environmental influence on the Euglenoids species diversity and their abundance in Museum Lake, Thiruvananthapuram, India. Curr. Sci. 2020;118(10):94-102.
2. Ali HA, Owaid MN, Ali SF. Recording thirteen new species of phytoplankton in Euphrates

river environmentinIraq.Walailak J.Sci.&Tech.2020;17(3):200-211.
3.AraujoGS,PachecoD,Cotas,J,AlvesDaSilvaW,SaboyaJ,MoreiraRT,PereiraL.
Planktoncommunities.In:LPereiraandAMGonacalves,editors.Plankton:Environmental

andeconomic importance for a sustainable future. IntechOpen, London, United Kingdom;2022.
4.BallotA,MjeldeM,SweT.IntegratedwaterresourcesmanagementinMyanmar; assessingecologicalstatusinInlayLake.NorwegianInstituteforWaterResearch PreliminaryReport7162;2017.
5.BallotA,SweT,MjeldeM,CerasinoL.,HostyevaV,MilesCO.Cylindrospermopsinand deoxycylindrospermopsin-producing*raphidiopsisraciborskii*andmicrocystinproducing microcystisspp. inMeiktilaLake,Myanmar.Toxins. 2020; 12(232): 1-23.
6.BhaktaS,AdhikarySP.Algaldiversityintwomajorriversofeastern Indiaand phycologicalassessmentoftheirpollution.Ecoscan.2012;**1**:07-14.
7.CameronNG.Diatommethods:useinArchaeology.In:ScottAEliasandCaryJMock, editors.Encyclopediaofquaternaryscience2nded.ElsevierAcademicPress.2013;516-521.
8. CCPK,ClimateChangeKnowledgePortal:WorldBank. Usermanual.2021.
9.DelwicheCF,CooperED.Theevolutionaryoriginofaterrestrialflora.Curr.Biol.2015; 25(19)R899-R910.
10.DineNawMW,SanDP,AungY.Occurrenceof*Microcystis*toxicbloomsinIndawgyi Lake,Kachinstate. UniversityofMandalay, ResearchJournal. 2020;11:1-9.
11.Enh S,Fang J,MaP,Liu B,Zhang H,Lan D,Yang Z,Dolka PC,WangZ.Astudyonthe characteristicsofdiatomsandecologicalenvironmentpollutioninthemainwaterofTianjin, China.20213rdInternational Conferenceon Geoscience andEnvironmental Chemistry (ICGEC2021) 290:03014. 5pp.
12.GerrathJF.Conjugatinggreenalgaeanddesmids.In:JDWehr,RGSheath,editors. FreshwateralgaeofNorthAmerica,ecologyandclassification,aquaticecology,1sted. ElsevierAcademicPress.2002;353-381.
13.HallJD,McCourtR.Zygnematophyta.In:JMArchibald,AlastairGB,SimpsonClaudio, HSlamovits,LMargulis,.Melkonian,DJChapman,JOCorlisseditors.Handbookofthe protists.Springer, Netherlands. 2017;1-29.
14.KorholaA.Diatommethods:Datainterpretation.In:CaryMock,ScottElias,editors. Encyclopediaof quaternaryscience2nded, ElsevierAcademicPress.2013, 494-507.
15.KhanMI,ShinJH,KimJD.Currentstatus,challenges,andoptimizationofasustainable andrenewableindustryforbiofuels,feed,andotherproducts.Microb.CellFactories.2018; 17(36):1-21.
16.KlymiukV,BarinovaS,LyalyukN.Diversityandecologyofalgalcommunitiesfromthe regionallandscapepark"slavyanskyresort",Ukraine. J.Bot. Sci. 2014;3(2):1-26.
17.KrienitzL.Algae.In:GeneELikens,editor.EncyclopediaofinlandWaters.Elsevier AcademicPress.2009;103-113.
18.LiberatoV,BenevenutiC,CoelhoF,BotelhoA,AmaralP,JrNeiPereiraandFerreiraT. *Clostridium* sp.asBio-catalystforfuelsandchemicalsproductioninabiorefinery context. Catalysts 2019,9(962):1-37.
19.NwezeNO.Ecologicalimplicationsandrolesofcyanobacteria(Cyanophyta)infood security.PlantProd.Res.J.2009;13:8-14.
20.PurbaIR,BarusTA,MulyaMB,IlyasS.Checklistofphytoplanktonandtheirabundance inTobaLake,NorthSumatra,Indonesia. AACLBioflux.2021;14(5):3104-3110.
21.PavelicP,SellamuttuSS,JohnstonR,McCartneyM,SotoukeeT,BalasubramanyaS, SuhardimanD,LacombeG,DouangsavanhS,JoffreO,LattK,ZanAK,TheinK,Myint, A,ChoC,HtutYT.Integratedassessmentofgroundwateruseforimprovinglivelihoodsin thedry zoneofMyanmar.IWMIResearchReports 229608,InternationalWaterManagement Institute.Colombo,SriLanka.2015;DOI:10.22004/ag.econ.229608
22. SSabater.Diatoms.In:GeneE. Likenseditors,Encyclopediaof inlandwaters. Elsevier AcademicPress.2009;149-156.
23.SannKK,SanNN,HtweTN,RehP.Studyonsomealgalspeciesofchlorophytafound

239 inNaung-Yar Lake,Loikaw,KayahState.3rdMyanmarKorea ConferenceResearch
240 Journal2018;l3(1):354-359.
241 24.SeinAM,KyawNSL,SoeWM.OccurrenceofmicroorganismsintheMyaKanThar
242 Lake,Loilemtownship,southernShanstate.PanglongUniversitiesResearchJournal.2017;
243 8:1-12.
244 25.SekimotoHiroyuki,AbeJun,TsuchikaneYuki.Newinsightsintotheregulationofsexual
245 reproductionin*Closterium.*Int. Rev.CellMol. Biol.2012; 297: 309-338.
246 26.SinghJS,KumarA,RaiAN,SinghDP.Cyanobacteria:Apreciousbio-resourcein
247 agriculture,ecosystemandenvironmentalsustainability.Front.Microbiol.2016; 7(529):1-19
248 27.SweT,MilesCO,CerasinoL,MjeldeM,KleivenS,BallotA.*Microcystis,Raphidiopsis*
249 *raciborskiiandDolichospermumsmithii*,toxinproducingandnon-toxigeniccyanobacteriain
250 YezinDam,Myanmar.Limnologica.2021;90(125901):1-9.
251 28.SzövényiP,WallerM,KirbisA.Evolutionofplantbodyplan.CurrentTopicsin
252 DevelopmentalBiology.2019;131:1-34.
253 29.TaylorEL,TaylorNThomas,KringsMichael.Algae.In: ThomasNTaylor,EdithL
254 Taylor,MichaelKrings,editors.Paleobotany,theBiologyandevolutionoffossilplants2nd
255 ed.Elsevier AcademicPress.2009;121-158.
256 30.VuurenS.Jansevan,Taylo,J,GerberA,vanGinkelC.EasyIdentificationofthemost
257 commonfreshwateralgae.Aguidefortheidentificationofmicroscopicalgaein South
258 Africanfreshwaters.North-WestUniversityandDepartmentofWaterAffairsandForestry.
259 2006;212.
260 31.WolanskiE,ElliottM.Estuarineecologicalstructureandfunctioning.In:EricWolanski
261 andMichaelElliott,editors.Estuarineecohydrology 2nded.Elsevier Academic Press.2015;
262 157-193